# LOAD FORECAST

# 1985-2000

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

STRATEGIC DEVELOPMENT

April 1985

## FOREWORD

This document presents a fifteen year forecast of in-province electrical load to be supplied by the New Brunswick Electric Power Commission (NB Power). The load forecast is arrived at after a cause and effect analysis of past loads, combined with a current assessment of economic, demographic, technological and related factors which affect future electrical utilization within New Brunswick. This April 1985 forecast replaces the forecast prepared in September 1984 and will be used as the starting point of much of the planning activity within NB Power.

The forecast is considered by NB Power to be the most likely outlook of the electrical requirements of the province. The loads presented are not targets but rather an expectation of what may occur given the current set of circumstances. The forecast provides a rational and consistent basis for detailed short term planning and general planning in the longer term. It must be remembered that the projections become progressively more uncertain in the later years of the forecast.

In view of the uncertainty associated with forecast inputs, this document includes a sensitivity analysis showing the effect of possible variations in key forecast input parameters.

This 1985 forecast of energy and peak demand requirements is somewhat higher than that prepared in 1984. The average annual rate of increase over the fifteen year period is 2.8% for energy sales and 2.9% for peak demand. The corresponding increases were 2.7% and 2.8% in the 1984 forecast. The difference in the two forecasts is primarily the result of a higher forecast of residential sales resulting from an increase in oil to electric space heating conversions.

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# EXECUTIVE SUMMARY

## EXECUTIVE SUMMARY

The electrical energy supply by NB Power to its in-province customers is forecast to increase from 10,003 gwh in the fiscal year ended March 1985 to 15,092 gwh in the year ending March 2000. This represents an average annual growth rate of 2.8%.

Peak demand related to the in-province energy supply is forecast to grow by 1000 MW from 1834 MW in the year 1985 to 2834 MW by the year 2000. This represents an average annual growth rate of 2.9%.

The overall end result of this 1985 forecast is somewhat higher than the 1984 corresponding period forecast of 2.7% annual increase in energy supply and an increase of 2.8% per year for peak demand (Table 1).

The difference between the two forecasts results in the 1984 forecast levels of energy supply and peak demand for the fiscal year 1991/92 to be attained one year earlier in 1990/91. This one year forward shift in load levels exists for the balance of the forecast period ending in the fiscal year 1999/2000.

The principal overall difference between the two forecasts relates to the upward revision of the number of residential oil to electric space heating conversions. All other inputs to the 1984 forecast were also reviewed and updated on the basis of new information. The following is a brief discussion on the key inputs to the forecast.

### RESIDENTIAL CUSTOMERS:

Forecast of number of customers is an input into the model for forecasting energy sales to residential customers. Customer forecast is a function of future population and the number of people in a household. The estimates of New Brunswick population since 1982 have been essentially the same as the NB Power forecast prepared in that year.

TABLE 1

| FISCAL YEAR | SYSTEM NET ENERGY (GW.h) | | SYSTEM PEAK DEMAND (MW) | |
|---|---|---|---|---|
| | 84 F'CST | 85 F'CST | 84 F'C | 85 F'CST |
| 1984/85 | 10017 | 10003 (ACT.) | 1832 | 1834 (ACT.) |
| 1985/86 | 10344 | 10378 | 1894 | 1911 |
| 1986/87 | 10682 | 10915 | 1968 | 2006 |
| 1987/88 | 11068 | 11327 | 2051 | 2102 |
| 1988/89 | 11476 | 11725 | 2134 | 2180 |
| 1989/90 | 11806 | 12046 | 2201 | 2246 |
| 1990/91 | 12070 | 12363 | 2255 | 2310 |
| 1991/92 | 12374 | 12679 | 2314 | 2374 |
| 1992/93 | 12675 | 12990 | 2372 | 2436 |
| 1993/94 | 12971 | 13293 | 2428 | 2495 |
| 1994/95 | 13265 | 13577 | 2484 | 2549 |
| 1995/96 | 13631 | 13932 | 2553 | 2616 |
| 1996/97 | 13927 | 14216 | 2608 | 2669 |
| 1997/98 | 14225 | 14501 | 2664 | 2723 |
| 1998/99 | 14532 | 14796 | 2720 | 2778 |
| 99/2000 | 14841 | 15092 | 2779 | 2834 |
| | ANNUAL GROWTH RATE (% PER YEAR) | | | |
| 5 YEAR PERIOD | 3.34 | 3.79 | 3.74 | 4.14 |
| 10 YEAR PERIOD | 2.85 | 3.10 | 3.09 | 3.35 |
| 15 YEAR PERIOD | 2.66 | 2.78 | 2.82 | 2.94 |

This population forecast which averages an increase of 4000 per year (0.5% annual growth) is somewhat lower than recent experience of 0.6% annual increase experienced since 1980 and in line with recent population projection recommendations by the Statistics Branch of the Provincial Department of Finance. The forecast of total households (year-round customers) by March 2000 has however increased from 273,065 in the previous (1984) forecast to 275,068 in this forecast. This change amounts to a decline in the number of persons per household from 2.84 to 2.82 by the year 2000 and results from an analysis of recent trends.

APPLIANCE OWNERSHIP/USE:

In January 1985 a mail survey of some 18,000 residential customers was conducted to determine the ownership and usage characteristics of household electrical appliances and equipment. The survey results based on nearly 8000 responses were found to be essentially the same as previous forecast levels for most applications excepting electric space and water heating, which showed higher actual ownership than NB Power forecast for the period. For example, the percentage of homes using electric space heating in New Brunswick is now estimated at 36.6% compared to a forecast of 34.6%. The reasons for this change and its implications on the residential sales is discussed below.

ELECTRIC SPACE HEAT:

Conversions of residential space and water heating systems from oil to the more economical alternative of using electricity continue to exceed forecast levels. Relatively high rate of conversions in recent months[1] resulted in 2% higher than forecast residential

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[1] In the fiscal year ended March 31, 1985 a total of 12,076 residential customers converted from oil to electric space heating (some 6000 of these conversions took place between January and March 1985 as compared to 1500 in the same period of 1984) compared to a forecast of 6000 for the year. This higher conversion rate in recent months was due mainly to the Federal Government's decision to terminate on March 31, 1985 an $800 grant for off-oil conversion.

energy sales in the fiscal year ended March 31, 1985. The current emphasis, by Marketing division, on conversion possibilities at the existing 100 ampere entrance or at the recently approved 125 ampere entrance will reduce the cost of potential conversions. It is expected that the annual rate of off-oil conversions will drop from the levels seen in recent months but would be higher than that included in the 1984 forecast. A total of 65,000 oil to electric space heat conversions in this fifteen year forecast reflect the potential identified on the basis of data collected from the January 1985 Appliance Saturation Survey. This new off-oil conversion forecast exceeds by 14,000 the previous (1984) estimate of 51,000 conversions in the same period. The percent of New Brunswick homes with electricity as principal space heating energy source will increase to 66.3% by the year 2000. This compares to the 60.8% level forecast in 1984.

ECONOMY:

The long term economic outlook for the province is an input into the forecast of sales to the General Service and Small Industrial Customer classification. Based on information compiled by NB Power, the real gross domestic provincial product is forecast to grow at a rate of 2.2% for each of the next fifteen years. This forecast of economic growth is unchanged from that prepared in September 1983. Economic growth often follows a cyclical pattern which can cause temporary fluctuations in electrical needs, particularly those of New Brunswick's resource based industry.

INDUSTRIAL DEVELOPMENT:

New industrial loads, which are known, including potash mines, antimony mines and a new coated paper mill are built into the load forecast. The timing and requirements are based on information gathered from the respective industries. Other loads which are identified but less certain are assigned probabilities and the resulting values are incorporated in the growth rate for the appropriate industrial sector.

The total additional load from known and identified industrial development is some 100 MW over the fifteen year forecast period.

ELECTRO-TECHNOLOGIES:

Industrial and commercial applications of new technologies are expected to result in increased electrical loads. Heat pumps, mechanical vapor recompression systems and heat exchangers are key examples of known applications. The related potential electrical load is estimated at 37 MW over the forecast period. This is about 7% of existing industrial load and has been included in the forecast. Other technological developments including plasma torches and reactors, electric vehicles, microwave applications to industrial drying are still in early stages of research and their potential effects have not been quantified but considered to be included in the 5 MW per year provision for unknown developments.

SYSTEM LOSSES

The forecast includes provision for losses incurred in transmission and distribution of electricity. Transmission losses dropped from about 7% of in-province supply in recent years to 6.3% in the fiscal year ended March 1985. The projection for the current year is for 6%, dropping to 5.5% of in-province supply in 1986. These reductions in transmission losses are related to the expansion of the 345 KV transmission facilities including a second tie with Hydro Quebec and a 345 KV line from Eel River to Keswick Via Grand Falls. The transmission loss percentage is forecast to increase to 6% by 1989 due to increases in load and then drop to 5.5% in 1991 reflecting planned upgrade of transmission facilities in 1990.

Distribution losses have averaged 5.7% of the supply at distribution voltages over the past five years. This level is forecast to remain constant over the forecast period.

Figures 1 and 2 show the history and forecast of in-province energy supply and peak demand. Table 2 gives the 1985 forecast by customer classification while the forecast growth is summarized in Table 3.

FIGURE 1

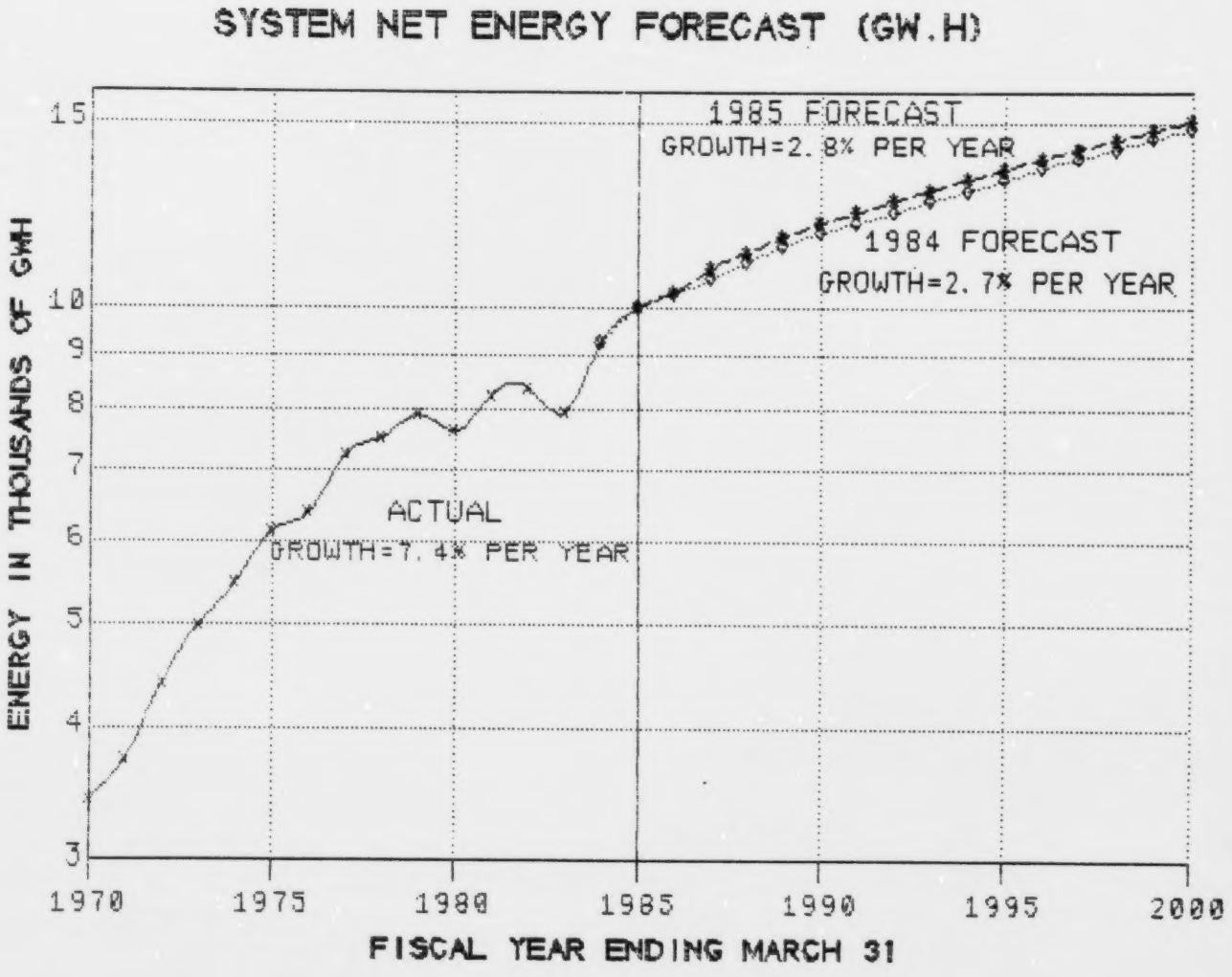
SYSTEM NET ENERGY FORECAST (GW.H)
1985 FORECAST
GROWTH=2.8% PER YEAR
1984 FORECAST
GROWTH=2.7% PER YEAR
ACTUAL
GROWTH=7.4% PER YEAR
ENERGY IN THOUSANDS OF GWH
15
10
9
8
7
6
5
4
3
1970
1975
1980
1985
1990
1995
2000
FISCAL YEAR ENDING MARCH 31

FIGURE 2

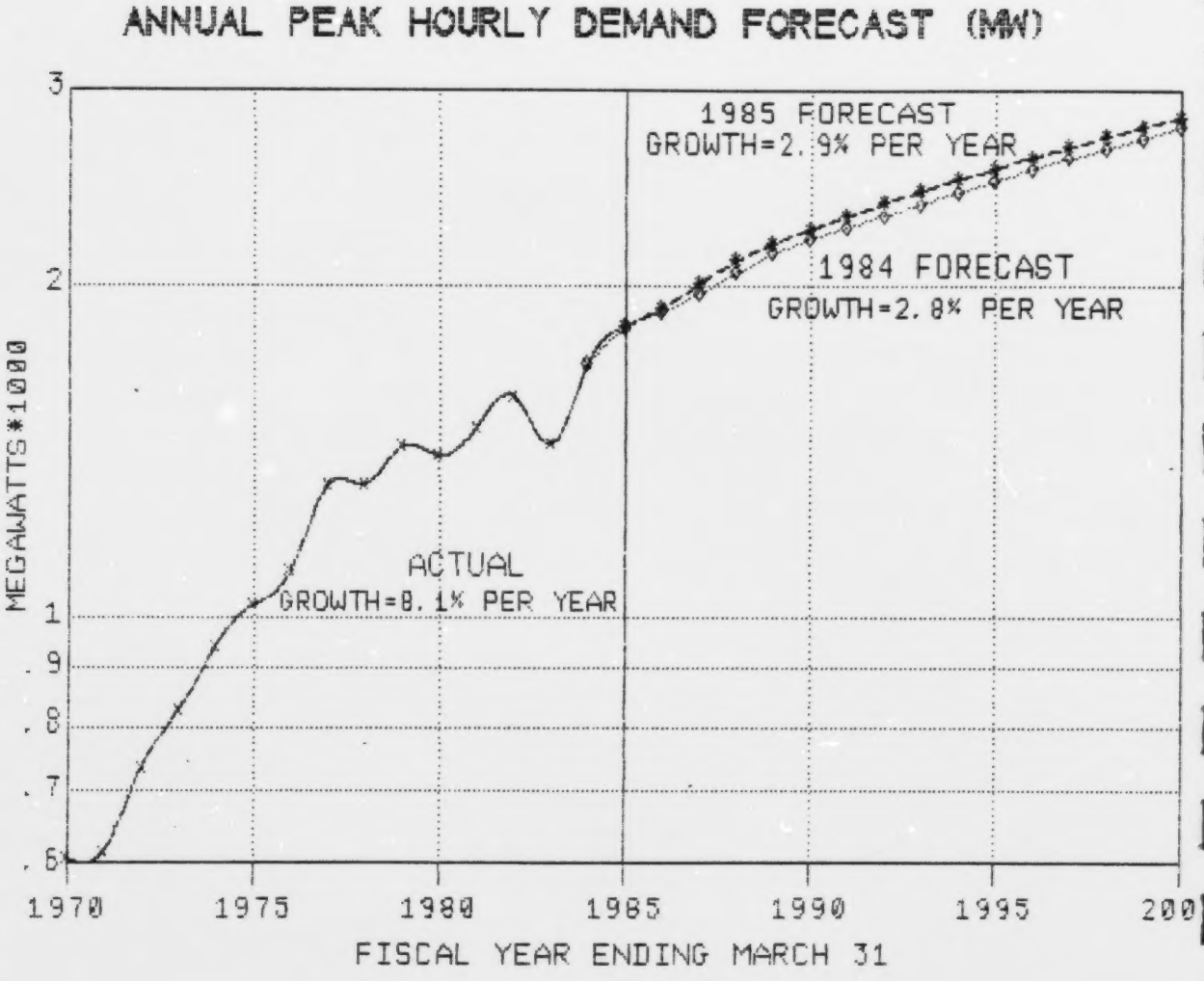
ANNUAL PEAK HOURLY DEMAND FORECAST (MW)
1985 FORECAST
GROWTH=2.9% PER YEAR
1984 FORECAST
GROWTH=2.8% PER YEAR
ACTUAL
GROWTH=8.1% PER YEAR
MEGAWATTS*1000
3
2
1
.9
.8
.7
.6
1970
1975
1980
1985
1990
1995
200
FISCAL YEAR ENDING MARCH 31

TABLE 2

ANNUAL ENERGY, PEAK DEMAND AND LOAD FACTOR FORECAST

| FISCAL YEAR | IN PROVINCE ENERGY SUPPLY (GWH) RESI-DENTIAL | GEN. SERVICE | STREET LIGHTS | IND. DIST. | IND. TRANS. | WHOLE-SALE | LOSSES | SYSTEM NET | HORLY PEAK DEM. (MW) | ANNUAL LOAD FACTOR(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1984/85 | 2713 | 1283 | 55 | 337 | 3943 | 784 | 888 | 10003 | 1834 | 62.3 |
| 1985/86 | 2957 | 1353 | 56 | 344 | 3994 | 834 | 840 | 10378 | 1911 | 62.0 |
| 1986/87 | 3149 | 1404 | 57 | 353 | 4192 | 875 | 884 | 10915 | 2006 | 62.1 |
| 1987/88 | 3321 | 1456 | 58 | 361 | 4295 | 914 | 921 | 11327 | 2102 | 61.5 |
| 1988/89 | 3473 | 1497 | 59 | 370 | 4423 | 947 | 955 | 11725 | 2180 | 61.4 |
| 1989/90 | 3590 | 1538 | 61 | 381 | 4517 | 976 | 982 | 12046 | 2246 | 61.2 |
| 1990/91 | 3702 | 1580 | 62 | 392 | 4612 | 1004 | 1010 | 12362 | 2310 | 61.1 |
| 1991/92 | 3811 | 1622 | 63 | 403 | 4709 | 1033 | 1037 | 12679 | 2374 | 61.0 |
| 1992/93 | 3913 | 1666 | 64 | 415 | 4806 | 1061 | 1064 | 12990 | 2436 | 60.9 |
| 1993/94 | 4008 | 1710 | 65 | 427 | 4904 | 1088 | 1090 | 13293 | 2495 | 60.8 |
| 1994/95 | 4087 | 1754 | 67 | 438 | 5004 | 1113 | 1113 | 13577 | 2549 | 60.8 |
| 1995/96 | 4163 | 1800 | 68 | 448 | 5104 | 1138 | 1210 | 13932 | 2616 | 60.8 |
| 1996/97 | 4237 | 1846 | 69 | 459 | 5206 | 1163 | 1235 | 14216 | 2669 | 60.8 |
| 1997/98 | 4311 | 1893 | 70 | 470 | 5308 | 1188 | 1261 | 14501 | 2723 | 60.8 |
| 1998/99 | 4385 | 1944 | 71 | 482 | 5412 | 1214 | 1287 | 14796 | 2778 | 60.8 |
| 99/2000 | 4458 | 1996 | 73 | 494 | 5517 | 1241 | 1312 | 15092 | 2834 | 60.8 |
| ANNUAL GROWTH RATE(%/YR.) | 3.37 | 2.99 | 2.00 | 2.58 | 2.26 | 3.11 | 2.64 | 2.78 | 2.94 | -0.16 |

TABLE 3

FORECAST GROWTH SUMMARRY

| | RESI-DENTIAL | GEN. SERVICE | STREET LIGHTS | IND. DIST. | IND. TRANS. | WHOLE-SALE | LOSSES | SYSTEM NET |
|---|---|---|---|---|---|---|---|---|
| 1984/85 SALES(GW.h) | 2713 | 1283 | 55 | 337 | 3943 | 784 | 888 | 10003 |
| % OF SYSTEM NET | 27.1 | 12.8 | 0.5 | 3.4 | 39.4 | 7.8 | 8.9 | 100.0 |
| GROWTH BY 1999/2000 | 1745 | 713 | 18 | 157 | 1574 | 457 | 424 | 5089 |
| % OF SYSTEM NET GROWTH | 34.3 | 14.0 | 0.4 | 3.1 | 30.9 | 9.0 | 8.3 | 100.0 |
| 1999/2000 SALES(GW.h) | 4458 | 1996 | 73 | 494 | 5517 | 1241 | 1312 | 15092 |
| % OF SYSTEM NET | 29.5 | 13.2 | 0.5 | 3.3 | 36.6 | 8.2 | 8.7 | 100.0 |
| ANNUAL GROWTH(%/YR.) | 3.37 | 2.99 | 2.00 | 2.58 | 2.26 | 3.11 | 2.64 | 2.78 |

# 1985 LOAD FORECAST

## INTRODUCTION

This document presents the methodology and results of the forecast of electrical power needs in New Brunswick. The forecast covers the fifteen year period from fiscal 1985/86 to 1999/2000 and includes a forecast of:

1) Annual electrical energy requirements of each of the six in-province customer classifications and the total distribution and transmission losses related to in-province sales.

2) Total in-province energy supply by month.

3) System net peak hourly demand by month.

Flow diagram in Figure 3 outlines the energy forecast methodology used for each of the six customer classifications; Residential, General Service, Industrial Distribution, Street Lights, Wholesale (for Resale) and Industrial Transmission. Figure 3 is followed by sections showing the basic framework and forecast results for each in-province customer classification, monthly spread of the total annual energy and peak demand and a final section on sensitivity analysis.

Some of the background material related to the details of methodology and inputs is given in Appendix A to D which are referenced in this main report.

FORECAST METHODOLOGY

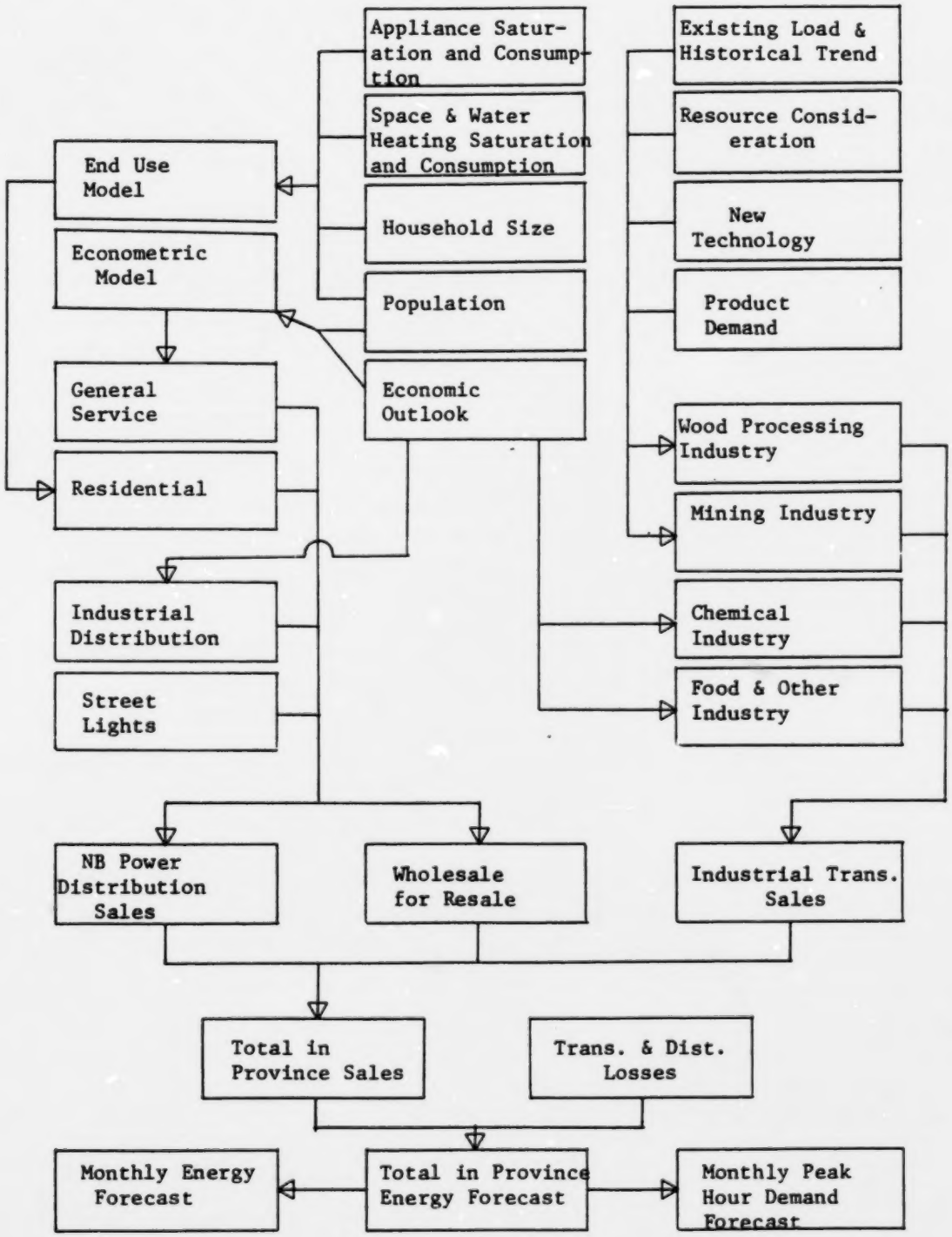


FIGURE 3

## ENERGY FORECAST BY CUSTOMER CLASSIFICATION

### 1. RESIDENTIAL

This classification comprises some 203,000 year-round and 15,000 seasonal customers served by NB Power. In addition there are over 32,000 year-round residential customers served by the municipal utilities of Saint John and Edmundston. Residential customers use electricity for household applications such as cooking, refrigeration, water heating and space heating. Churches and farms are also included in this group.

The average annual growth rate from 1971/72 to 1984/85 is 9.6% resulting in a total energy sale to residential customers of 3055 GWh in 1984/85 or more than three times the 1971/72 sales. The annual growth rate forecasted for a period of 15 years starting from 1985 is 3.37 percent.

The forecast growth rate is lower than historical experience mainly because of the following changes:

a) The high growth in the number of households (and therefore residential customers) in early and mid seventies was not sustained in the late seventies and early eighties. Further reductions in the growth in households are forecast during the rest of the eighties and again in the nineties (see Appendix A for details). Consequently, this will reduce the numbers of new households, i.e. customers in the future.

b) Ownership of many major household appliances which grew rapidly in sixties and seventies is approaching saturation levels. For example, from 1970 to 1979 the saturation level of domestic electric hot water heater went from 22.5% to 64.8% or the saturation level increased by an average of 4.7% per year. The corresponding increase has been 2.2% per year in the last five years.

c) Other factors include: (i) the use of wood particularly as supplement to electric space heating[1] and (ii) energy conservation in response to increased customer awareness and encouragement from the Federal and Provincial government programs designed to encourage conservation.

The residential energy is forecast separately for the year-round customers (households, farms and churches accounting for 99% of the residential sales) and seasonal customers. The forecast of year-round customers' needs is based on an "end use" model which can be simply stated as:

ENERGY (kW.h) = NUMBER OF YEAR-ROUND CUSTOMERS
X AVERAGE USE PER CUSTOMER.

Forecast of the number of year-round customers is based on projections of population and household size (see Appendix A for details). The number of year-round residential classified customers is forecast to increase from the 1984/85 level of 235,520 to 275,068 by 1999/2000.

Use per customer is determined by the estimates of the number of major electrical appliances and their average annual use in kilowatthours (see Appendix B for details). The average annual consumption of year-round customers is forecast to grow from 12,946 kW.h experienced in 1984/85 to 18,042 kW.h in 1999/2000. Principal factor leading to this growth is the forecast increase in electric space heating which is expected to increase from 36.6% in 1984/85 to 66.3% by the year 1999/2000. This will be in large part due to forecast of 64,000 oil to electric space heat conversions over the next fifteen years. Electric space heating penetration into new construction is forecast at 100% till 1988/89 then declining gradually to 65% by 1993/94 to reflect the potential availability of natural gas in the province.

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(1) January 1985 Appliance Saturation Survey indicates that 51% of the electric heated homes use wood as supplementary heating fuel.

The seasonal customer growth rate is forecast at 200 units a year and the corresponding use per customer is forecast by extrapolating historical trends. Seasonal customers' share of the total residential energy will remain stable at around one percent of the total residential consumption.

The total residential sales forecast is for compound average annual growth of 3.37%. NB Power does not retail directly to all of the households using electricity in the province. The portion of the total residential forecast sales expected to be retailed by the municipal utilities in Saint John and Edmundston is determined on the basis of historical data.

Table 4 gives the history and forecast of residential sales and Table 5 shows the history and forecast of NB population, total residential customers, residential sales per person and sales per customer.

TABLE 4

HISTORY AND FORECAST OF RESIDENTIAL SALES (GW.h)

| Fiscal Year | NB POWER | WHOLESALE | TOTAL SALES NEW BRUNSWICK |
|---|---|---|---|
| History | | | |
| 1971-72 | 785 | 150 | 935 |
| 1972-73 | 911 | 162 | 1073 |
| 1973-74 | 1072 | 179 | 1251 |
| 1974-75 | 1284 | 203 | 1487 |
| 1975-76 | 1554 | 243 | 1797 |
| 1976-77 | 1809 | 275 | 2084 |
| 1977-78 | 1905 | 278 | 2183 |
| 1978-79 | 2010 | 256 | 2266 |
| 1979-80 | 1975 | 254 | 2229 |
| 1980-81 | 2057 | 255 | 2312 |
| 1981-82 | 2119 | 263 | 2382 |
| 1982-83 | 2226 | 278 | 2508 |
| 1983-84 | 2484 | 308 | 2792 |
| 1984-85 | 2713 | 342 | 3055 |
| Forecast | | | |
| 1985-86 | 2957 | 369 | 3327 |
| 1986-87 | 3149 | 393 | 3542 |
| 1987-88 | 3321 | 415 | 3735 |
| 1988-89 | 3473 | 434 | 3907 |
| 1989-90 | 3590 | 448 | 4038 |
| 1990-91 | 3702 | 462 | 4165 |
| 1991-92 | 3811 | 476 | 4286 |
| 1992-93 | 3913 | 489 | 4401 |
| 1993-94 | 4008 | 500 | 4509 |
| 1994-95 | 4087 | 510 | 4597 |
| 1995-96 | 4163 | 520 | 4683 |
| 1996-97 | 4237 | 529 | 4767 |
| 1997-98 | 4311 | 538 | 4849 |
| 1998-99 | 4385 | 547 | 4932 |
| 99-2000 | 4458 | 557 | 5015 |

TABLE 5

RESIDENTIAL SALES PER PERSON AND PER CUSTOMER

| Fiscal Year | Total Sales New Brunswick (kWh*1000000) | N.B. Population | Total * Residential Customers | kWh/Person (1)/(2) | kWh/cust. (1)/(3) |
|---|---|---|---|---|---|
| History | | | | | |
| 1971-72 | 935 | 636,400 | 174,568 | 1469 | 5356 |
| 1972-73 | 1073 | 642,400 | 182,300 | 1670 | 5886 |
| 1973-74 | 1251 | 649,300 | 191,263 | 1927 | 6541 |
| 1974-75 | 1487 | 657,500 | 200,375 | 2262 | 7421 |
| 1975-76 | 1797 | 669,200 | 207,549 | 2685 | 8658 |
| 1976-77 | 2084 | 679,600 | 216,571 | 3067 | 9623 |
| 1977-78 | 2183 | 685,800 | 223,072 | 3183 | 9786 |
| 1978-79 | 2266 | 690,200 | 228,425 | 3283 | 9920 |
| 1979-80 | 2229 | 693,800 | 232,719 | 3213 | 9578 |
| 1980-81 | 2312 | 696,300 | 236,664 | 3320 | 9769 |
| 1981-82 | 2382 | 698,300 | 238,787 | 3411 | 9975 |
| 1982-83 | 2508 | 703,700 | 241,657 | 3564 | 10378 |
| 1983-84 | 2792 | 709,200 | 246,503 | 3937 | 11326 |
| 1984-85 | 3055 | 714,600 | 250,890 | 4275 | 12177 |
| Forecast | | | | | |
| 1985-86 | 3327 | 719,900 | 254,592 | 4621 | 13066 |
| 1986-87 | 3542 | 725,100 | 258,352 | 4885 | 13711 |
| 1987-88 | 3735 | 730,000 | 261,953 | 5117 | 14259 |
| 1988-89 | 3907 | 734,800 | 265,308 | 5317 | 14725 |
| 1989-90 | 4038 | 739,300 | 268,457 | 5462 | 15043 |
| 1990-91. | 4165 | 743,600 | 271,539 | 5601 | 15337 |
| 1991-92 | 4286 | 747,800 | 274,455 | 5732 | 15618 |
| 1992-93 | 4401 | 751,700 | 277,205 | 5855 | 15877 |
| 1993-94 | 4509 | 755,400 | 279,743 | 5969 | 16118 |
| 1994-95 | 4597 | 758,900 | 282,156 | 6058 | 16293 |
| 1995-96 | 4683 | 762,200 | 284,455 | 6144 | 16462 |
| 1996-97 | 4767 | 765,300 | 286,671 | 6228 | 16627 |
| 1997-98 | 4849 | 768,400 | 288,892 | 6311 | 16785 |
| 1998-99 | 4932 | 771,500 | 291,162 | 6393 | 16939 |
| 99-2000 | 5015 | 774,600 | 293,438 | 6474 | 17090 |

* Include seasonal customers .

## 2. GENERAL SERVICE

This classification comprises all customers who do not specifically fall into residential, industrial or street lighting categories. The general service customers range from a few kilowatts to several thousand kilowatts of connected load. The electric applications for this customer group can also be diverse, ranging for example from basic lighting needs in a small office to lighting, heating, cooling and operation of medical equipment in a hospital.

Sales to New Brunswick's general service customers have more than doubled since the fiscal year 1971/72 - with an average annual increase of 6.9 percent over the thirteen year period. The growth in the most recent five year period has been much slower at 2.8% per year. This difference in growth rate over the two periods can be linked to (i) differences in economic growth (2.7% vs 0.5%), (ii) population growth (0.9% vs. 0.5%) and (iii) the effect of energy conservation which has not been quantified but is evident from the success of several federal and provincial government programs aimed at promoting conservation.

Based on analysis of electrical use of general service customers by Standard Industrial Classification Code (SIC), it is estimated that nearly 70% of the general service sales are directly linked to economic activity e.g. hotels/motels, retail outlets, offices. The remaining 30% of the sales are to the institutional sector including schools, hospitals and government offices. Institutional sector sales are also linked to economic factors in the long run but often influenced by public policy in the short run.

As all of the general service sales are directly or indirectly linked to the economic activity within the province, the econometric model used in the previous forecasts is one relevant forecast approach. The existing model was updated with revised and additional electrical energy and economic data. Model results have been consistent with actual experience in the past three years and form the basis of this forecast.

The model defines annual general service sales per capita as a dependent variable while per capita real personal disposable income is used as the independent variable. Forecast growth in per capita real personal disposable income is based on the potential for future growth in total real domestic provincial product and takes into account the impact of current trends in wage restraints.(2)

Per capita general service sales forecast is multiplied by the New Brunswick population projection to arrive at the total general service sales forecast. The model results are obtained based on a 1.75% annual increase in per capita real personal disposable income(2) and 0.5% annual growth in population.(3)

Table 7 gives the forecast results for general service sales per capita and total New Brunswick. The total general service sales forecast is for a compound average annual growth rate of 2.99 percent. Table 6 gives the history and forecast of general service sales for NB Power and the municipal utilities (wholesale). The portion of the total general service sales expected to be retailed by the municipal utilities is determined on the basis of recent historical data.

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(2) See "General Service Forecast, 1983-1999" by Hon-Po Wong, NB Power.
(3) See Residential section and Appendix A for discussion on population projection.

TABLE 6

HISTORY AND FORECAST OF
GENERAL SERVICE SALES (GW.h)

| FISCAL YEAR | | NB POWER | WHOLESALE | TOTAL SALES NEW BRUNSWICK |
|---|---|---|---|---|
| 1971/72 | ACTUAL | 540 | 167 | 707 |
| 1972/73 | | 618 | 181 | 799 |
| 1973/74 | | 695 | 200 | 895 |
| 1974/75 | | 775 | 222 | 997 |
| 1975/76 | | 872 | 252 | 1124 |
| 1976/77 | | 935 | 274 | 1209 |
| 1977/78 | | 984 | 282 | 1266 |
| 1978/79 | | 1072 | 275 | 1347 |
| 1979/80 | | 1118 | 288 | 1406 |
| 1980/81 | | 1165 | 296 | 1461 |
| 1981/82 | | 1169 | 306 | 1475 |
| 1982/83 | | 1184 | 323 | 1507 |
| 1983/84 | | 1227 | 341 | 1568 |
| 1984/85 | | 1283 | 350 | 1633 |
| | FORECAST | | | |
| 1985/86 | | 1353 | 368 | 1721 |
| 1986/87 | | 1404 | 382 | 1786 |
| 1987/88 | | 1456 | 396 | 1853 |
| 1988/89 | | 1497 | 407 | 1904 |
| 1989/90 | | 1538 | 419 | 1956 |
| 1990/91 | | 1580 | 430 | 2010 |
| 1991/92 | | 1622 | 442 | 2064 |
| 1992/93 | | 1666 | 454 | 2119 |
| 1993/94 | | 1710 | 465 | 2175 |
| 1994/95 | | 1754 | 478 | 2232 |
| 1995/96 | | 1800 | 490 | 2290 |
| 1996/97 | | 1846 | 503 | 2349 |
| 1997/98 | | 1893 | 516 | 2409 |
| 1998/99 | | 1944 | 529 | 2473 |
| 99-2000 | | 1996 | 543 | 2539 |

TABLE 7

GENERAL SERVICE SALES PER PERSON

| FISCAL YEAR | N.B. POPULATION AS OF OCTOBER 1 ST | N.B. GEN.SER. SALES (Million kW.h) | GEN.SER. SALES PER PERSON (kW.h) |
|---|---|---|---|
| ACTUAL | | | |
| 1981/82 | 698300 | 1475 | 2112 |
| 1982/83 | 703700 | 1507 | 2141 |
| 1983/84 | 709200 | 1568 | 2211 |
| 1984/85 | 714600 | 1633 | 2285 |
| FORECAST | | | |
| 1985/86 | 719900 | 1721 | 2391 |
| 1986/87 | 725100 | 1786 | 2463 |
| 1987/88 | 730000 | 1853 | 2538 |
| 1988/89 | 734800 | 1904 | 2591 |
| 1989/90 | 739300 | 1956 | 2646 |
| 1990/91 | 743600 | 2010 | 2703 |
| 1991/92 | 747800 | 2064 | 2760 |
| 1992/93 | 751700 | 2119 | 2819 |
| 1993/94 | 755400 | 2175 | 2880 |
| 1994/95 | 758900 | 2232 | 2941 |
| 1995/96 | 762200 | 2290 | 3004 |
| 1996/97 | 765300 | 2349 | 3069 |
| 1997/98 | 768400 | 2409 | 3135 |
| 1998/99 | 771500 | 2473 | 3205 |
| 99/2000 | 774600 | 2539 | 3278 |
| AVERAGE ANNUAL GROWTH (%/YR.) | 0.5% | 2.99% | 2.4% |

## 3. INDUSTRIAL DISTRIBUTION

This customer classification comprises of industrial customers served at distribution voltages (12 kV or less) and ranging in size from a few KW to about 3000 KW of connected load. Some 70% of the sales to this customer classification are to the manufacturing industries while water and sewage pumping accounts for about 15% of the total sales.

Historical year to year growth rate for the classification has not been very consistent. The fluctuations in growth rate have resulted from swings in economy and due to shifts of loads between industrial transmission and distribution classifications.

Key considerations in forecasting Industrial Distribution electrical requirements are: (a) the growth in the provincial economy as measured by the total real domestic provincial product and by its goods producing and manufacturing sector components, (b) potential for conservation and (c) application of new electro-technology to existing industry, e.g. heat pumps and dehumidification heat pump kilns.

The energy sales to this classification are forecast to grow at an overall average rate of 2.58% per year as compared to 4.5% growth in the past 13 years. The difference is due to forecast of slower than past economic growth[4] and the potential for energy conservation, particularly through the use of energy efficient motors which are economically justified for decisions relating to new and replacement motors.[5]

The history and forecast of total New Brunswick Industrial Distribution sales and its NB Power and Wholesale components is given in Table 8.

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(4) Wong, Hon-Po, General Service Forecast, 1983-1999, NB Power.
(5) Potential of high efficiency motors to save electric energy in Canada, CEA Research Project 016 U 244.

TABLE 8

HISTORY AND FORECAST OF
INDUSTRIAL DISTRIBUTION SALES (GW.h)

| | NB POWER | WHOLESALE | TOTAL SALES NEW BRUNSWICK |
|---|---|---|---|
| ACTUAL | | | |
| 1971/72 | 189 | 36 | 225 |
| 1972/73 | 199 | 42 | 241 |
| 1973/74 | 205 | 46 | 251 |
| 1974/75 | 217 | 51 | 268 |
| 1975/76 | 238 | 57 | 295 |
| 1976/77 | 251 | 62 | 313 |
| 1977/78 | 255 | 64 | 319 |
| 1978/79 | 283 | 58 | 341 |
| 1979/80 | 306 | 58 | 364 |
| 1980/81 | 321 | 58 | 379 |
| 1981/82 | 293 | 60 | 353 |
| 1982/83 | 283 | 58 | 341 |
| 1983/84 | 311 | 60 | 371 |
| 1984/85 | 337 | 61 | 398 |
| FORECAST | | | |
| 1985/86 | 344 | 64 | 408 |
| 1986/87 | 353 | 66 | 418 |
| 1987/88 | 361 | 68 | 429 |
| 1988/89 | 370 | 70 | 440 |
| 1989/90 | 381 | 70 | 451 |
| 1990/91 | 392 | 71 | 463 |
| 1991/92 | 403 | 71 | 474 |
| 1992/93 | 415 | 72 | 487 |
| 1993/94 | 427 | 72 | 499 |
| 1994/95 | 438 | 74 | 512 |
| 1995/96 | 448 | 77 | 525 |
| 1996/97 | 459 | 79 | 538 |
| 1997/98 | 470 | 82 | 552 |
| 1998/99 | 482 | 84 | 566 |
| 99/2000 | 494 | 86 | 580 |

## 4. STREET LIGHTS

The sales to this customer classification include energy sold to street lights owned by NB Power and the two municipal utilities, customer owned facilities, off street dusk-to-dawn lights and other services such as railway crossing signals. The energy sales to this classification are just over one half of one percent of the total in-province supply.

In the seventies the street lights energy requirements grew rapidly at a rate of 8.8% between fiscal 1971/72 and 1979/80. The growth rate since fiscal 1979/80 has been 2.3% percent per year. This decline in street lights energy growth rate reflects (i) slower rate of household construction, (ii) development of low wattage high efficiency lighting, (iii) financial restraints by municipal governments and (iv) development of residential areas outside municipalities not serviced by street lights.

The potential for application of more energy efficient street lights is large and expected to be realized gradually as existing lights need replacement. This will continue to offset much of the new growth in street lighting requirements.

The forecast growth rate of two (2) percent per year is in line with experience over the past five years. The forecast of total New Brunswick Street Lights sales and its NB Power and Wholesale components are given in Table 9.

TABLE 9

HISTORY AND FORECAST OF
STREET LIGHT SALES (GW.h)

| | NB POWER | WHOLESALE | TOTAL SALES NEW BRUNSWICK |
|---|---|---|---|
| ACTUAL | | | |
| 1971/72 | 25 | 11 | 36 |
| 1972/73 | 27 | 12 | 39 |
| 1973/74 | 30 | 12 | 42 |
| 1974/75 | 35 | 11 | 46 |
| 1975/76 | 39 | 11 | 50 |
| 1976/77 | 42 | 11 | 53 |
| 1977/78 | 44 | 12 | 56 |
| 1978/79 | 47 | 10 | 57 |
| 1979/80 | 49 | 10 | 59 |
| 1980/81 | 50 | 11 | 61 |
| 1981/82 | 51 | 12 | 63 |
| 1982/83 | 52 | 12 | 64 |
| 1983/84 | 53 | 12 | 65 |
| 1984/85 | 55 | 12 | 67 |
| FORECAST | | | |
| 1985/86 | 56 | 12 | 68 |
| 1986/87 | 57 | 13 | 69 |
| 1987/88 | 58 | 13 | 71 |
| 1988/89 | 59 | 13 | 72 |
| 1989/90 | 60 | 13 | 73 |
| 1990/91 | 61 | 14 | 75 |
| 1991/92 | 63 | 14 | 76 |
| 1992/93 | 64 | 14 | 78 |
| 1993/94 | 65 | 14 | 80 |
| 1994/95 | 66 | 15 | 81 |
| 1995/96 | 68 | 15 | 83 |
| 1996/97 | 69 | 15 | 84 |
| 1997/98 | 71 | 16 | 86 |
| 1998/99 | 72 | 16 | 88 |
| 99/2000 | 73 | 16 | 90 |

## 5. WHOLESALE (FOR RESALE)

A portion of the residential, general service, industrial distribution and street lights energy is not sold directly by NB Power to the customer but through the two municipal utilities in Saint John and Edmundston. These utilities purchase electricity from NB Power at transmission voltages and distribute it to the ultimate consumers.

The Wholesale energy is forecast by allocating the total New Brunswick sales, for each of the four customer classifications identified above, to NB Power and Wholesale portions on the basis of historical data. Sales by municipal utilities and the related distribution losses are added to obtain the Wholesale Transmission forecast.

The Wholesale energy forecast is for a compound average annual growth rate of 3.11 percent over the next fifteen years. Forecast results are given in Table 10.

TABLE 10

HISTORY AND FORECAST OF SALES
TO WHOLESALE CUSTOMERS (GW.h)

| | RESIDENTIAL | GENERAL SERVICE | INDUSTRIAL DISTRIBUTION | STREET LIGHTS | TOTAL* SALES |
|---|---|---|---|---|---|
| HISTORY | | | | | |
| 1971/72 | 150 | 167 | 36 | 11 | 373 |
| 1972/73 | 162 | 181 | 42 | 12 | 408 |
| 1973/74 | 179 | 200 | 46 | 12 | 450 |
| 1974/75 | 203 | 222 | 51 | 11 | 499 |
| 1975/76 | 243 | 252 | 57 | 11 | 562 |
| 1976/77 | 275 | 274 | 62 | 11 | 615 |
| 1977/78 | 278 | 282 | 64 | 12 | 633 |
| 1978/79 | 256 | 275 | 58 | 10 | 609 |
| 1979/80 | 254 | 288 | 58 | 10 | 624 |
| 1980/81 | 255 | 296 | 58 | 11 | 644 |
| 1981/82 | 263 | 306 | 60 | 12 | 659 |
| 1982/83 | 278 | 323 | 58 | 12 | 686 |
| 1983/84 | 308 | 341 | 60 | 12 | 744 |
| 1984/85 | 342 | 350 | 61 | 12 | 784 |
| FORECAST | | | | | |
| 1985/86 | 369 | 368 | 64 | 12 | 834 |
| 1986/87 | 393 | 382 | 66 | 13 | 875 |
| 1987/88 | 415 | 396 | 68 | 13 | 915 |
| 1988/89 | 434 | 407 | 70 | 13 | 948 |
| 1989/90 | 448 | 419 | 70 | 13 | 976 |
| 1990/91 | 462 | 430 | 71 | 14 | 1004 |
| 1991/92 | 476 | 442 | 71 | 14 | 1033 |
| 1992/93 | 489 | 454 | 72 | 14 | 1061 |
| 1993/94 | 500 | 465 | 72 | 14 | 1088 |
| 1994/95 | 510 | 478 | 74 | 15 | 1113 |
| 1995/96 | 520 | 490 | 77 | 15 | 1138 |
| 1996/97 | 529 | 503 | 79 | 15 | 1163 |
| 1997/98 | 538 | 516 | 82 | 16 | 1188 |
| 1998/99 | 547 | 529 | 84 | 16 | 1214 |
| 99/2000 | 557 | 543 | 86 | 16 | 1241 |

* Total includes distribution losses incurred by municipal utilities.

## 6. INDUSTRIAL TRANSMISSION

This classification has about forty large industrial customers each with its individual substation and supplied electrical energy at transmission voltages. The customers, ranging in size from nearly one to one hundred megawatts, fall into four main industrial categories; wood processing, mining, chemical (including petroleum refining) and other. There are three types of sales in this classification: (a) firm, (b) interruptible, and (c) contract.

### (a) Firm Sales:

The requirements of large industrial customers related to the amount of power contracted and reserved by the customer are defined as firm sales. Since the fiscal year 1971/72 the firm energy requirements, which account for over 90% of the sales to this classification, have grown at 5.7% per year.

The forecast of firm sales involves, (i) an analysis of each individual customer needs in the short term (three years) and (ii) the analysis of the long term load growth prospects.

Electrical requirements of individual customers in the short term are established by (i) reviewing the existing contractual agreement of peak load reserved by the customer, (ii) analysis of historical load patterns, (iii) customer expectations obtained through contacts with management/technical experts at customer location and (iv) impact of current economic trends on the demand for customers' products. Individual customer data is excluded from this report to maintain customer confidentiality.

The long term (years four to fifteen) load growth potential is based on economic, technological, resource availability and product demand considerations. As it is difficult to forecast the timing of new loads in the distant future, the load growth potential for each of the four industry groups is translated into an annual rate of growth.

Wood processing (mainly pulp and paper) industry, which represents almost three quarters of the total firm energy sales, is forecast to grow at 1.4% per year from the fiscal year 1987/88 to 1999/2000 (see Appendix C for details). Mining industry, accounting for some 18% of the total firm energy, is forecast to grow at 2.0% per year in the long term (see Appendix D for details). The growth for chemical and other industry groups is based mainly on economic growth potential and is also forecast at 2.0% per year.

All electric utilities frequently face requests for electrical services arising from unforeseen developments in existing or new industry. Potential load related to unforeseen developments over the forecast period is included at 5 MW/year for the years four through fifteen, amounting to a little less than one percent (1%) annual increase in firm load.

The total increase in firm load forecast amounts to about 13 MW/year over the forecast period. This compares to 17.6 MW/year experienced in the past thirteen years. The difference reflects (i) slower than historical economic growth forecast and (ii) the unlikely repetition of the recent load additions (of about 100 MW) due to modernization and expansion in the pulp and paper industry.(6)

The firm industrial transmission energy, is forecast to grow at a rate of 2.5% over the next fifteen years. The forecast does not make provision for future economic swings and their effects on industrial electrical requirements because, (i) it is almost impossible to forecast the timing and duration of the economic swings and (ii) the swings have little bearing on the principal applications of this long term load forecast. Forecast results by industry group are shown in Table 11.

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(6) As outlined in Appendix C, due to resource considerations, the potential for growth due to modernization and expansion over the forecast period is very limited in comparison to recent experience.

(b) Contract Sales:

Contract load is based on a single customer; a co-generation facility for the sale of steam and electricity from NB Power's Courtenay Bay No. 2 unit in Saint John.

(c) Interruptible Sales:

Interruptible power can be purchased by Industrial Transmission customers as a replacement for their own generating capacity. The forecast of 260 GW.h/year is in line with current trends and expectations.

The overall industrial transmission energy is forecast to grow at a compound average annual rate of 2.25% per year. Forecast results are shown in Table 12.

TABLE 11

FIRM TRANSMISSION FORECAST BY INDUSTRY TYPE

FISCAL YEAR ENDING MARCH 31

| INDUSTRY\YEAR: | 1986 | 1987 | 1988 | 1989 | 1990 | ... | 1995 | ... | 2000 |
|---|---|---|---|---|---|---|---|---|---|
| Wood Proc.: | | | | | | | | | |
| Peak load(MW) | 355.6 | 364.2 | 376.2 | 381.2 | 386.0 | | 410.7 | | 437.0 |
| Load Factor(%) | 84.8 | 87.8 | 87.8 | 87.8 | 87.8 | | 87.8 | | 87.8 |
| Energy(GW.h) | 2642.3 | 2799.7 | 2833.0 | 2930.4 | 2967.0 | | 3157.1 | | 3359.5 |
| Mining: | | | | | | | | | |
| Peak load(MW) | 101.6 | 104.8 | 106.1 | 108.0 | 110.0 | | 120.2 | | 131.4 |
| Load Factor(%) | 77.4 | 78.7 | 80.0 | 80.0 | 80.0 | | 80.0 | | 80.0 |
| Energy(GW.h) | 688.6 | 722.8 | 738.3 | 756.9 | 770.6 | | 842.4 | | 921.0 |
| Chemical: | | | | | | | | | |
| Peak load(MW) | 31.9 | 32.4 | 35.0 | 36.1 | 37.1 | | 43.0 | | 49.9 |
| Load Factor(%) | 80.8 | 80.6 | 70.0 | 70.0 | 70.0 | | 70.0 | | 70.0 |
| Energy(GW.h) | 225.7 | 228.7 | 244.9 | 221.1 | 227.7 | | 264.0 | | 306.0 |
| Food/Other: | | | | | | | | | |
| Peak load(MW) | 25.8 | 26.3 | 26.5 | 27.0 | 27.6 | | 30.4 | | 33.6 |
| Load Factor(%) | 46.2 | 46.8 | 46.9 | 47.0 | 47.1 | | 47.6 | | 48.1 |
| Energy(GW.h) | 104.3 | 107.7 | 110.5 | 111.2 | 113.7 | | 126.8 | | 141.5 |
| Sub Total: | | | | | | | | | |
| Peak load(MW) | 514.9 | 527.7 | 543.8 | 552.3 | 560.6 | | 604.4 | | 652.0 |
| Load Factor(%) | 81.2 | 83.5 | 82.4 | 83.1 | 83.1 | | 82.9 | | 82.8 |
| Energy(GW.h) | 3660.8 | 3859.0 | 3926.6 | 4019.6 | 4078.9 | | 4390.4 | | 4728.0 |
| All. for Dev.: | | | | | | | | | |
| Peak load(MW) | | | 5.0 | 10.0 | 15.0 | | 40.0 | | 65.0 |
| Load Factor(%) | | | 80.0 | 80.0 | 80.0 | | 80.0 | | 80.0 |
| Energy(GW.h) | | | 35.0 | 70.1 | 105.1 | | 280.3 | | 455.5 |
| Total: | | | | | | | | | |
| Peak load(MW) | 514.9 | 527.7 | 548.8 | 562.3 | 575.6 | | 644.4 | | 717.0 |
| Load Factor(%) | 81.2 | 83.5 | 82.4 | 83.0 | 83.0 | | 88.2 | | 82.5 |
| Energy(GW.h) | 3660.8 | 3859.0 | 3961.7 | 4089.7 | 4184.1 | | 4670.7 | | 5183.5 |

TABLE 12

HISTORY AND FORECAST OF
INDUSTRIAL TRANSMISSION SALES (GW.h)

| FISCAL YEAR | FIRM LOAD | CONTRACT | INTERRUP -TIBLE | TOTAL SALES |
|---|---|---|---|---|
| HISTORY | | | | |
| 1971/72 | 1752 | 382 | 42 | 2176 |
| 1972/73 | 2005 | 388 | 61 | 2454 |
| 1973/74 | 2089 | 331 | 89 | 2509 |
| 1974/75 | 2232 | 320 | 99 | 2651 |
| 1975/76 | 2254 | 53 | 74 | 2381 |
| 1976/77 | 2666 | 75 | 116 | 2857 |
| 1977/78 | 2758 | 80 | 140 | 2978 |
| 1978/79 | 2872 | 68 | 168 | 3108 |
| 1979/80 | 2630 | 25 | 198 | 2853 |
| 1980/81 | 2933 | 75 | 293 | 3301 |
| 1981/82 | 2957 | 62 | 229 | 3248 |
| 1982/83 | 2517 | 46 | 233 | 2796 |
| 1983/84 | 3221 | 66 | 283 | 3570 |
| 1984/85 | 3596 | 70 | 277 | 3943 |
| FORECAST | | | | |
| 1985/86 | 3661 | 73 | 260 | 3994 |
| 1986/87 | 3859 | 73 | 260 | 4192 |
| 1987/88 | 3962 | 73 | 260 | 4295 |
| 1988/89 | 4090 | 73 | 260 | 4423 |
| 1989/90 | 4184 | 73 | 260 | 4517 |
| 1990/91 | 4279 | 73 | 260 | 4612 |
| 1991/92 | 4376 | 73 | 260 | 4709 |
| 1992/93 | 4473 | 73 | 260 | 4806 |
| 1993/94 | 4571 | 73 | 260 | 4904 |
| 1994/95 | 4671 | 73 | 260 | 5004 |
| 1995/96 | 4771 | 73 | 260 | 5104 |
| 1996/97 | 4873 | 73 | 260 | 5206 |
| 1997/98 | 4975 | 73 | 260 | 5308 |
| 1998/99 | 5079 | 73 | 260 | 5412 |
| 99/2000 | 5184 | 73 | 260 | 5517 |

## MONTHLY ENERGY FORECAST

In order for the load forecast to be used effectively in the overall utility planning process it is necessary to know the monthly energy consumption pattern. Annual forecast of each customer classification is allocated into months based on historical patterns and the nature of forecast growth.

Residential monthly forecast is based on weather adjusted historical data for sales in the most recent fiscal year and allocation of the forecast energy growth to its space heating and other components. Energy growth related to forecast additional electric space heating in a given year is allocated into heating months on the basis of customer consumption analysis. Non-space heating energy growth is allocated uniformly throughout the twelve months.

Historical weather adjusted sales to the general service and the sales to street lights classification show a stable pattern. The annual forecast for these two classifications has been allocated over twelve months on the basis of past trends.

Some forty percent of the wholesale energy is related to residential customers and therefore sensitive to space heating additions. Residential part of the wholesale energy is thus allocated in the same manner as NB Power Residential sales while the remaining increase has been spread uniformly over the year.

Industrial Distribution and Transmission energy has been allocated on the basis of past patterns. However data considered abnormal due to unusual conditions, e.g. strike or economy related shutdowns, was excluded in determining historical pattern.

The monthly distribution sales, i.e. Residential, General Service, Street Lights and Industrial Distribution, were adjusted upwards for the distribution losses to determine total energy supply to these customers.

The adjustment was made on the basis of five year historical average supply to sales ratio for each month.

Total monthly in-province energy (Table 13) includes distribution supply, industrial and wholesale transmission energy and a provision for transmission losses.

TABLE 13

SYSTEM NET MONTHLY ENERGY (GW.h)

| YR.\MO. | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1984/85 | 825 | 789 | 717 | 685 | 721 | 704 | 803 | 852 | 943 | 1080 | 928 | 956 | 10003 |
| 1985/86 | 862 | 809 | 745 | 707 | 753 | 724 | 826 | 893 | 986 | 1096 | 978 | 998 | 10378 |
| 1986/87 | 912 | 846 | 777 | 736 | 783 | 758 | 869 | 939 | 1046 | 1159 | 1033 | 1057 | 10915 |
| 1987/88 | 950 | 874 | 799 | 757 | 804 | 782 | 901 | 974 | 1095 | 1210 | 1077 | 1104 | 11327 |
| 1988/89 | 987 | 901 | 823 | 778 | 826 | 807 | 932 | 1007 | 1141 | 1257 | 1118 | 1149 | 11725 |
| 1989/90 | 1016 | 924 | 842 | 795 | 844 | 827 | 957 | 1035 | 1177 | 1294 | 1150 | 1184 | 12046 |
| 1990/91 | 1045 | 946 | 861 | 813 | 863 | 847 | 982 | 1061 | 1213 | 1330 | 1182 | 1219 | 12363 |
| 1991/92 | 1074 | 968 | 881 | 831 | 881 | 868 | 1007 | 1088 | 1248 | 1366 | 1214 | 1253 | 12679 |
| 1992/93 | 1102 | 990 | 900 | 849 | 900 | 888 | 1032 | 1114 | 1283 | 1401 | 1245 | 1287 | 12990 |
| 1993/94 | 1129 | 1012 | 919 | 867 | 918 | 908 | 1056 | 1140 | 1316 | 1435 | 1274 | 1319 | 13293 |
| 1994/95 | 1155 | 1032 | 937 | 885 | 937 | 927 | 1078 | 1164 | 1346 | 1466 | 1302 | 1349 | 13577 |
| 1995/96 | 1186 | 1058 | 961 | 907 | 960 | 951 | 1106 | 1194 | 1384 | 1504 | 1336 | 1385 | 13932 |
| 1996/97 | 1211 | 1079 | 979 | 925 | 978 | 971 | 1129 | 1217 | 1414 | 1535 | 1363 | 1415 | 14216 |
| 1997/98 | 1237 | 1100 | 998 | 943 | 997 | 990 | 1151 | 1241 | 1444 | 1565 | 1390 | 1445 | 14501 |
| 1998/99 | 1263 | 1121 | 1018 | 961 | 1016 | 1011 | 1175 | 1266 | 1475 | 1597 | 1418 | 1475 | 14796 |
| 99/2000 | 1289 | 1143 | 1037 | 980 | 1036 | 1031 | 1198 | 1291 | 1507 | 1629 | 1446 | 1506 | 15092 |

## MONTHLY PEAK HOURLY DEMAND

The timing of new facilities depends to a large degree on the forecast of peak hourly demand on the system and its components. The most significant factor in the determination of the peak demand is the corresponding load factor.

Monthly load factors over the past five years were examined for the energy supplied at distribution voltages and for the sales to the Wholesale classification customers at transmission voltages. No specific trend could be established in either set of load factors. Most fluctuations were found to be weather related. Averages of the last five years load factors were used as the basis for non-coincident peak demand related to Distribution and Wholesale energy.

Load factors for industrial customers served at transmission voltages are based on an analysis and projection of each individual customer's requirements for the first three years of the forecast. From years four to fifteen the load factor is projected for each of the four main industrial groups. The provision for unforeseen industrial development was included at 80% annual load factor. This formed the basis of non-coincident industrial peak demand given in Table 11. In addition a provision of 12 MW for contract load and 30 MW for interruptible load has been added to the peak demand forecast.

The total non-coincident peak demand obtained by adding variable and industrial components is adjusted for diversity and then translated to peak hourly load. Both of these adjustments are based on historical relationships. Table 14 gives the resulting forecast of system peak hourly demand.

TABLE 14

SYSTEM NET PEAK HOURLY DEMAND (MW)

| YR.\MO. | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | MAX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1984/85 | 1519 | 1355 | 1274 | 1169 | 1231 | 1282 | 1341 | 1535 | 1646 | 1806 | 1834 | 1769 | 1834 |
| 1985/86 | 1545 | 1474 | 1326 | 1271 | 1326 | 1351 | 1489 | 1647 | 1807 | 1911 | 1836 | 1735 | 1911 |
| 1986/87 | 1619 | 1529 | 1369 | 1307 | 1363 | 1379 | 1552 | 1716 | 1901 | 2006 | 1926 | 1824 | 2006 |
| 1987/88 | 1697 | 1589 | 1419 | 1350 | 1408 | 1450 | 1620 | 1788 | 1997 | 2102 | 2018 | 1914 | 2102 |
| 1988/89 | 1760 | 1636 | 1457 | 1383 | 1443 | 1491 | 1674 | 1847 | 2076 | 2180 | 2092 | 1988 | 2180 |
| 1989/90 | 1814 | 1679 | 1493 | 1415 | 1477 | 1530 | 1722 | 1898 | 2142 | 2246 | 2154 | 2050 | 2246 |
| 1990/91 | 1866 | 1722 | 1529 | 1447 | 1511 | 1568 | 1769 | 1948 | 2207 | 2310 | 2215 | 2111 | 2310 |
| 1991/92 | 1919 | 1764 | 1565 | 1479 | 1545 | 1607 | 1815 | 1997 | 2271 | 2374 | 2276 | 2172 | 2374 |
| 1992/93 | 1970 | 1806 | 1601 | 1512 | 1579 | 1645 | 1861 | 2046 | 2333 | 2436 | 2335 | 2231 | 2436 |
| 1993/94 | 2020 | 1847 | 1637 | 1544 | 1613 | 1682 | 1906 | 2094 | 2394 | 2495 | 2392 | 2288 | 2495 |
| 1994/95 | 2065 | 1885 | 1671 | 1575 | 1646 | 1718 | 1948 | 2138 | 2449 | 2549 | 2444 | 2339 | 2549 |
| 1995/96 | 2122 | 1934 | 1713 | 1615 | 1688 | 1763 | 1999 | 2193 | 2516 | 2616 | 2508 | 2403 | 2616 |
| 1996/97 | 2167 | 1972 | 1748 | 1646 | 1721 | 1800 | 2041 | 2236 | 2570 | 2669 | 2560 | 2454 | 2669 |
| 1997/98 | 2213 | 2011 | 1782 | 1679 | 1755 | 1836 | 2083 | 2281 | 2625 | 2723 | 2611 | 2506 | 2723 |
| 1998/99 | 2260 | 2051 | 1818 | 1712 | 1790 | 1874 | 2126 | 2326 | 2681 | 2778 | 2664 | 2559 | 2778 |
| 99/2000 | 2307 | 2092 | 1854 | 1746 | 1826 | 1912 | 2169 | 2372 | 2737 | 2834 | 2717 | 2613 | 2834 |

## FORECAST SENSITIVITIES

The 1985 forecast presented in this document reflects what is considered to be the most likely outlook at this time. The effect of ±1% deviation in annual growth rate, on system net energy and peak demand forecasts is shown in Tables 15 and 16 below.

### TABLE 15

### ENERGY FORECAST VARIATIONS

| Year | (1) 1985 Forecast (GW.h) | (2) 1985 Forecast +1.0%/yr | (3) 1985 Forecast -1.0%/yr | (4) Differences (GW.h) (2) - (1) | (5) Differences (GW.h) (3) - (1) |
|---|---|---|---|---|---|
| 1984/85 (Actual) | 10003 | 10003 | 10003 | - | - |
| 1989/90 | 12046 | 12638 | 11477 | 592 | -569 |
| 1994/95 | 13577 | 14953 | 12316 | 1376 | -1261 |
| 1999/2000 | 15092 | 17451 | 13033 | 2359 | -2059 |

### TABLE 16

### DEMAND FORECAST VARIATIONS

| Year | (1) 1985 Forecast (MW ) | (2) 1985 Forecast +1.0%/yr | (3) 1985 Forecast -1.0%/yr | (4) Differences (MW) (2) - (1) | (5) Differences (MW) (3) - (1) |
|---|---|---|---|---|---|
| 1984/85 (Actual) | 1834 | 1834 | 1834 | - | - |
| 1989/90 | 2246 | 2357 | 2141 | 111 | -105 |
| 1994/95 | 2549 | 2807 | 2312 | 258 | -237 |
| 1999/2000 | 2834 | 3276 | 2447 | 442 | -387 |

The effect of variations in specific forecast parameters on the total system net energy and on the average annual growth rate is shown in the following Table 17.

The combined effect of the changes identified in Table 18 is between -1860 GW.h and +1363 GW.h, i.e. if the actual situation were such as to render the five variables to either of the two extremes the system net energy forecast for 1999/2000 would be either higher by 1363 GW.h or lower by 1860 GW.h. The effect on annual growth rate is between +0.6 and -0.9 percent.

TABLE 17

SENSITIVITY TO SPECIFIC FORECAST PARAMETERS

| | Forecast Variable | Input In 1985 Forecast | Change In Input Parameter | Effect on System Net Energy By Fiscal 1999/2000 | |
|---|---|---|---|---|---|
| | | | | GW.h | Annual Growth Rate (%) |
| (1) | Off-oil Residential Space Heat Conversions | Average of 4360/year | ± 1000 Conversions per year | ± 249 | ± 0.11 |
| (2) | New housing starts | Average of 2600/year | ± 1000 New homes per year | ± 405 | ± 0.18 |
| (3) | Conservation Effect on Space Heat Energy Requirements | 0.5%/year | ± 0.5%/year | ± 224 | ± 0.10 |
| (4) | Fuel Wood Use by Residential Customers | Total quantity will remain unchanged | Will maintain its proportion of space heating energy | - 497 | - 0.22 |
| (5) | Industrial Unknown Load Additions | 5 MW/year | ± 5 MW/year | ± 485 | ± 0.21 |

APPENDIX TO

1985 LOAD FORECAST

APPENDIX A

## NUMBER OF CUSTOMERS

Residential "end use" forecast model requires a forecast of the number of year-round customers (households) and the use per customer. Customer forecast methodology is discussed in this Appendix and use per customer is the subject of the next Appendix B.

The historical growth in NB Power year-round customers can be related to (i) growth in population and (ii) the number of people per household. Since the fiscal year 1971/72 the population of New Brunswick has grown from 636,400 to 714,600 representing an average annual growth of 0.9% per year. During the same period the number of year-round residential customers has increased from 163,068 to 235,520 or at an annual rate of 2.9% per year. The higher historical growth rate for the number of customers (more than three times the population growth rate) reflects the decline in number of people per household from 3.90 to 3.03 (see Table A1). Population and household size forecasts are discussed below.

### Population

Future population is a function of three factors: births, deaths and migration. The accuracy of any population forecast is therefore dependent on the ability to forecast each of these factors.

Births are a function of fertility rates and the female population in the child bearing age. Fertility rate fluctuates with socio-economic conditions and is difficult to forecast. Number of deaths which depend on the mortality rate for each age group show a relatively stable trend and are more predictable. Migration patterns are generally linked to economic conditions and perhaps the most difficult component of a population forecast.

TABLE A 1

POPULATION AND HOUSEHOLD HISTORY

| Fiscal Year | (1) Population of New Brunswick | (2) Year-Round Customers | (1)/(2) Persons per Customer |
|---|---|---|---|
| History | | | |
| 1971-72 | 636,400 | 163,068 | 3.90 |
| 1972-73 | 642,400 | 170,500 | 3.77 |
| 1973-74 | 649,300 | 179,163 | 3.62 |
| 1974-75 | 657,500 | 187,875 | 3.50 |
| 1975-76 | 669,200 | 194,749 | 3.44 |
| 1976-77 | 679,600 | 203,071 | 3.35 |
| 1977-78 | 685,800 | 209,272 | 3.28 |
| 1978-79 | 690,200 | 214,425 | 3.22 |
| 1979-80 | 693,800 | 218,319 | 3.18 |
| 1980-81 | 696,300 | 221,829 | 3.14 |
| 1981-82 | 698,300 | 224,325 | 3.11 |
| 1982-83 | 703,700 | 226,487 | 3.11 |
| 1983-84 | 709,200 | 231,333 | 3.07 |
| 1984-85 | 714,600 | 235,520 | 3.03 |
| Forecast | | | |
| 1985-86 | 719,900 | 239,022 | 3.01 |
| 1986-87 | 725,100 | 242,582 | 2.99 |
| 1987-88 | 730,000 | 245,983 | 2.97 |
| 1988-89 | 734,800 | 249,138 | 2.95 |
| 1989-90 | 739,300 | 252,087 | 2.93 |
| 1990-91 | 743,600 | 254,969 | 2.92 |
| 1991-92 | 747,800 | 257,685 | 2.90 |
| 1992-93 | 751,700 | 260,235 | 2.89 |
| 1993-94 | 755,400 | 262,573 | 2.88 |
| 1994-95 | 758,900 | 264,786 | 2.87 |
| 1995-96 | 762,200 | 266,885 | 2.86 |
| 1996-97 | 765,300 | 268,901 | 2.85 |
| 1997-98 | 768,400 | 270,922 | 2.84 |
| 1998-99 | 771,500 | 272,992 | 2.83 |
| 99-2000 | 774,600 | 275,068 | 2.82 |

The uncertainty associated with fertility rates can be avoided for the purpose of forecasting households. This is done by basing future households forecast on population of age 15 and over; the population considered capable of forming households within the duration of this fifteen year forecast.

As previously mentioned the mortality rates show a stable pattern and are relatively easy to forecast. The long term pattern for net migration is very difficult to forecast. A zero net migration assumption would minimize the overall forecast error and is therefore considered to be the best choice.

In 1982 NB Power prepared a forecast of total population and population over the age of fifteen based on the Statistics Canada projections of fertility and mortality rates and assuming zero net migration over the period. The actual population since then has been in line with the 1982 forecast.

Statistics Canada has also released (yet unpublished) a series of eighteen different population projections. We reviewed these projections and selected the best option to be the one with near zero inter-provincial migration, low international in-migration and constant fertility rate. The choice is consistent with current trends, expectations and the criteria for minimizing the forecast error. Statistics Canada projection based on the above assumptions is somewhat lower than the estimated actual at this time. NB Power's 1982 population projection, which has been in line with actual experience for the past three years, is only slightly different from Statistics Canada projection, and has therefore been used in this forecast (Table A2).

Household Size (Headship Rate)

Forecast of the number of customers is based on the headship rate (proportion of people of age 15 and over who are year-round customers) and population of age 15 and over. The high growth in headship rate in

TABLE A 2

POPULATION HISTORY AND FORECAST

| Fiscal Year | Population of New Brunswick | Population Growth Rate | Population Age 15 And Over | Growth Rate Age 15 And Over |
|---|---|---|---|---|
| History | | | | |
| 1971-72 | 636,400 | | 434,200 | |
| 1972-73 | 642,400 | 0.94% | 442,800 | 1.98% |
| 1973-74 | 649,300 | 1.07% | 452,100 | 2.10% |
| 1974-75 | 657,500 | 1.26% | 462,200 | 2.23% |
| 1975-76 | 669,200 | 1.78% | 476,100 | 3.01% |
| 1976-77 | 679,600 | 1.55% | 487,600 | 2.42% |
| 1977-78 | 685,800 | 0.91% | 496,600 | 1.85% |
| 1978-79 | 690,200 | 0.64% | 505,100 | 1.71% |
| 1979-80 | 693,800 | 0.52% | 513,100 | 1.58% |
| 1980-81 | 696,300 | 0.36% | 519,400 | 1.23% |
| 1981-82 | 698,300 | 0.29% | 525,400 | 1.16% |
| 1982-83 | 703,700 | 0.77% | 532,900 | 1.43% |
| 1983-84 | 709,200 | 0.78% | 539,800 | 1.29% |
| 1984-85 | 714,600 | 0.76% | 546,400 | 1.22% |
| Forecast | | | | |
| 1985-86 | 719,900 | 0.74% | 553,100 | 1.23% |
| 1986-87 | 725,100 | 0.72% | 559,900 | 1.23% |
| 1987-88 | 730,000 | 0.68% | 566,300 | 1.14% |
| 1988-89 | 734,800 | 0.66% | 572,100 | 1.02% |
| 1989-90 | 739,300 | 0.61% | 577,400 | 0.93% |
| 1990-91 | 743,600 | 0.58% | 582,800 | 0.94% |
| 1991-92 | 747,800 | 0.56% | 587,800 | 0.86% |
| 1992-93 | 751,700 | 0.52% | 592,400 | 0.78% |
| 1993-94 | 755,400 | 0.49% | 596,500 | 0.69% |
| 1994-95 | 758,900 | 0.46% | 600,300 | 0.64% |
| 1995-96 | 762,200 | 0.43% | 604,100 | 0.63% |
| 1996-97 | 765,300 | 0.41% | 607,700 | 0.60% |
| 1997-98 | 768,400 | 0.41% | 611,300 | 0.59% |
| 1998-99 | 771,500 | 0.40% | 615,000 | 0.61% |
| 99-2000 | 774,600 | 0.40% | 618,700 | 0.60% |

early and mid seventies was not sustained in the late seventies and early eighties. The slower growth in headship rate in recent years reflects the relative stabilization in the family size at around 3 people per household. This is partly due to tougher economic times which have made it difficult for younger people to set up independent households. Forecast of headship rate is predicted to slow down again in the future to reflect the stabilization in the family size. A negative exponential growth is considered to be the most likely scenario. The forecast growth in headship rate is 0.11% per year from 1985 to 1990, 0.09% from 1991 to 1995 and 0.07% from 1996 to 2000. This compares to actual growth of 0.92% per year from 1975-1980 and 0.26% per year from 1980 to 1985. Table A3 gives the forecast of population aged 15 and over, headship rate and the number of households (year-round customers).

The seasonal customers who account for some 1% of residential energy sales are forecast to increase at a rate of 200 per year (somewhat below the historical average of 300 per year experienced since 1972). Year-round, seasonal and total residential customer history and forecast is given in Table A4.

TABLE A 3
YEAR-ROUND RESIDENTIAL CUSTOMERS

| Fiscal Year | (1) POP. AGE 15 AND OVER | (2) HEADSHIP RATE | (1)*(2)/100 YEAR-ROUND CUSTOMERS |
|---|---|---|---|
| History | | | |
| 1971-72 | 434,200 | 37.556 | 163,068 |
| 1972-73 | 442,800 | 38.505 | 170,500 |
| 1973-74 | 452,100 | 39.629 | 179,163 |
| 1974-75 | 462,200 | 40.648 | 187,875 |
| 1975-76 | 476,100 | 40.905 | 194,749 |
| 1976-77 | 487,600 | 41.647 | 203,071 |
| 1977-78 | 496,600 | 42.141 | 209,272 |
| 1978-79 | 505,100 | 42.452 | 214,425 |
| 1979-80 | 513,100 | 42.549 | 218,319 |
| 1980-81 | 519,400 | 42.709 | 221,829 |
| 1981-82 | 525,400 | 42.696 | 224,325 |
| 1982-83 | 532,900 | 42.501 | 226.487 |
| 1983-84 | 539,800 | 42.853 | 231,333 |
| 1984-85 | 546,400 | 43.104 | 235,520 |
| Forecast | | | |
| 1985-86 | 553,100 | 43.215 | 239,022 |
| 1986-87 | 559,900 | 43.326 | 242,582 |
| 1987-88 | 566,300 | 43.437 | 245,983 |
| 1988-89 | 572,100 | 43.548 | 249,138 |
| 1989-90 | 577,400 | 43.659 | 252,087 |
| 1990-91 | 582,800 | 43.749 | 254,969 |
| 1991-92 | 587,800 | 43.839 | 257,685 |
| 1992-93 | 592,400 | 43.929 | 260,235 |
| 1993-94 | 596,500 | 44.019 | 262,573 |
| 1994-95 | 600,300 | 44.109 | 264,786 |
| 1995-96 | 604,100 | 44.179 | 266,885 |
| 1996-97 | 607,700 | 44.249 | 268,901 |
| 1997-98 | 611,300 | 44.319 | 270,922 |
| 1998-99 | 615,000 | 44.389 | 272,992 |
| 99-2000 | 618,700 | 44.459 | 275,068 |

TABLE A 4

TOTAL RESIDENTIAL CUSTOMERS

| Fiscal Year | (1) Year-Round Customers | (2) Seasonal Customers | (1)+(2) Total Res. Customers |
|---|---|---|---|
| History | | | |
| 1971-72 | 163,068 | 11,500 | 174568 |
| 1972-73 | 170,500 | 11,800 | 182300 |
| 1973-74 | 179,163 | 12,100 | 191263 |
| 1974-75 | 187,875 | 12,500 | 200375 |
| 1975-76 | 194,749 | 12,800 | 207549 |
| 1976-77 | 203,071 | 13,300 | 216571 |
| 1977-78 | 209,272 | 13,800 | 223072 |
| 1978-79 | 214,425 | 14,000 | 228425 |
| 1979-80 | 218,319 | 14,400 | 232719 |
| 1980-81 | 221,829 | 14,835 | 236664 |
| 1981-82 | 224,325 | 14,462 | 238787 |
| 1982-83 | 226,487 | 15,170 | 241657 |
| 1983-84 | 231,333 | 15,170 | 246503 |
| 1984-85 | 235,520 | 15,370 | 250890 |
| Forecast | | | |
| 1985-86 | 239,022 | 15,570 | 254592 |
| 1986-87 | 242,582 | 15,770 | 258352 |
| 1987-88 | 245,983 | 15,970 | 261953 |
| 1988-89 | 249,138 | 16,170 | 265308 |
| 1989-90 | 252,087 | 16,370 | 268457 |
| 1990-91 | 254,969 | 16,570 | 271539 |
| 1991-92 | 257,685 | 16,770 | 274455 |
| 1992-93 | 260,235 | 16,970 | 277205 |
| 1993-94 | 262,573 | 17,170 | 279743 |
| 1994-95 | 264,786 | 17,370 | 282156 |
| 1995-96 | 266,885 | 17,570 | 284455 |
| 1996-97 | 268,901 | 17,770 | 286671 |
| 1997-98 | 270,922 | 17,970 | 288892 |
| 1998-99 | 272,992 | 18,170 | 291162 |
| 99-2000 | 275,068 | 18,370 | 293438 |

APPENDIX B

## ENERGY USE PER CUSTOMER

The energy use per customer depends on the number of various electrical appliances (or equipment) in use and the average annual use per appliance.

Data on the existing number of electrical appliances in use, by year-round customers, is determined through customer surveys. The most recent such survey was conducted in January 1985. The future saturation levels are based on estimates of each appliance's penetration into new homes and the potential for addition in existing homes. Forecast of two key electrical applications, which account for over 60 percent of the total residential energy use, is detailed below.

### Electric Space and Water Heating

In 1983/84 electricity was estimated to be the principal source of space heating energy for 31.1% of year-round customers. This increased to 36.6% in the January 1985 survey. The change amounted to an increase of some 12,500 new electric space heat customers - 9,000[1] from off-oil conversions and the remaining due to an estimated 100% penetration of electric heating in the 3500 new year-round customers.

Some 29,000 residential customers converted from oil to electric space heating since the implementation of the Canada Oil Substitution Program (COSP); a federal government grant program which gave customers up to $800 towards the cost of converting from oil to an alternate heating source. The grant program ended on March 31, 1985. The economic

(1) The actual number of oil to electric conversions in the fiscal year 1984/85 was 12,076. Of these the conversions affecting the full winter's energy requirement are estimated to be equal to 9,000.

benefits of conversion have however been enhanced by the option to convert at 100 amp. or 125 amp. entrance. This should offset the loss of grant and result in the rate of conversion to electricity to remain high. The number of conversion is forecast at 10,000[2] in 1985/86, 7,000 in 1986/87, 6000 per year in 1987/88 and 1988/89, and then dropping to 4000 per year. This rate will continue until 1994/95 then decline to 3000 per year, resulting in a total of 65,000 off-oil conversions over the forecast period.

All of the new homes are also forecast to opt for electric heating, based on the availability and economics of alternate sources. The penetration of electric heating is forecast to drop gradually, to 65% by the fiscal year 1993/94 to allow for potential availability of natural gas.

The methodology for forecasting future numbers of electric water heating customers is similar to that for space heating. The key difference is that not all of the off-oil space heating conversions will result in additional electric water heating, since some 56.6% [3] of the existing oil heated customers already have an electric water heater.

Aside from the number of appliances in use we also need to know the average annual electrical use per appliance to determine the consumption per customer.

The average electrical requirement of an electric space heated home is estimated at some 14,000 kW.h per year. This figure includes the effect of use of wood as supplementary heating fuel in many of these homes. Estimates for electrical space heating requirements, without wood as a supplementary heating fuel, range around 17,500 kW.h/year.[4]

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(2) Includes 3,000 from fiscal year 1984/85.
(3) 1985 Appliance Saturation Survey
(4) Provincial Department of the Energy Secretariat is one source of this estimate.

Data on wood supply and utilization indicates that the total amount of wood used as a space heating fuel has stabilized[5] and can be expected to remain constant at this level, over the forecast period. This has been confirmed by the changes in electrical consumption corresponding to the electrically heated homes added in the past two years.

The estimate of annual electrical space heating energy and for other applications were input into the residential "end use" model. The model results were in line with the actual experience in the fiscal year 1984/85 (Table B1) as has been the case for the last five years. The "end use" model has been used to forecast residential sales.

Table B2 to B4 give the results of the "end use" model for every fifth year of the forecast, showing changes in average annual use per year-round customer (household). The increasing contribution of electric space heating to the average annual consumption is related to the increasing saturation level of electric space heating which changes from 36.6% in 1985 to 66.3% by 1999/2000.

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(5) Statistics Canada Catalogue 25-201.

TABLE B1

END USE ESTIMATES FOR RESIDENTIAL ELECTRICAL USE
FISCAL YEAR 1984/85

| | ELECTRICAL APPLIANCE OR EQUIPMENT | SATURATION LEVEL | ANNUAL APPLIANCE CONSUMPTION (kWh) | CONTRIBUTION TO AVERAGE HOUSEHOLD CONSUMPTION (kWh) | % OF TOTAL |
|---|---|---|---|---|---|
| (1) | HEATING SYSTEM | 36.6% | 14058 | 5140 | 39.7 |
| (2) | WATER HEATER | 73.3% | 3920 | 2873 | 22.2 |
| (3) | REFRIGERATOR | 100.0% | 1256 | 1256 | 9.7 |
| (4) | COOKING STOVE | 94.5% | 1129 | 1067 | 8.2 |
| (5) | FREEZER | 60.8% | 846 | 514 | 4.0 |
| (6) | DISHWASHER | 31.6% | 360 | 114 | 0.9 |
| (7) | CLOTHES WASHER | 85.1% | 90 | 77 | 0.6 |
| (8) | CLOTHES DRYER | 76.2% | 900 | 686 | 5.3 |
| (9) | TELEVISION | 100.0% | 380 | 380 | 2.9 |
| (10) | AIR CONDITIONER | 7.7% | 500 | 39 | 0.3 |
| (11) | LIGHTING | 100.0% | 600 | 600 | 4.6 |
| (12) | MISCELANEOUS | 100.0% | 201 | 201 | 1.6 |
| (13) | TOTAL | | | 12946 | 100.0 |

TABLE II

END USE ESTIMATES FOR RESIDENTIAL ELECTRICAL USE
FISCAL YEAR 1989/90

| | ELECTRICAL APPLIANCE OR EQUIPMENT | SATURATION LEVEL | ANNUAL APPLIANCE CONSUMPTION (kWh) | CONTRIBUTION TO AVERAGE HOUSEHOLD CONSUMPTION (kWh) | % OF TOTAL |
|---|---|---|---|---|---|
| (1) | HEATING SYSTEM | 52.7% | 14402 | 7590 | 47.8 |
| (2) | WATER HEATER | 80.0% | 3920 | 3135 | 19.8 |
| (3) | REFRIGERATOR | 100.0% | 1288 | 1288 | 8.1 |
| (4) | COOKING STOVE | 98.3% | 1074 | 1056 | 6.7 |
| (5) | FREEZER | 69.3% | 825 | 572 | 3.6 |
| (6) | DISHWASHER | 39.1% | 360 | 141 | 0.9 |
| (7) | CLOTHES WASHER | 84.1% | 90 | 76 | 0.5 |
| (8) | CLOTHES DRYER | 79.2% | 900 | 712 | 4.5 |
| (9) | TELEVISION | 100.0% | 399 | 399 | 2.5 |
| (10) | AIR CONDITIONER | 8.7% | 500 | 44 | 0.3 |
| (11) | LIGHTING | 100.0% | 600 | 600 | 3.8 |
| (12) | MISCELANEOUS | 100.0% | 257 | 257 | 1.6 |
| (13) | TOTAL | | | 15969 | 100.0 |

TABLE B3

END USE ESTIMATES FOR RESIDENTIAL ELECTRICAL USE
FISCAL YEAR 1994/95

| | ELECTRICAL APPLIANCE OR EQUIPMENT | SATURATION LEVEL | ANNUAL APPLIANCE CONSUMPTION (kWh) | CONTRIBUTION TO AVERAGE HOUSEHOLD CONSUMPTION (kWh) | % OF TOTAL |
|---|---|---|---|---|---|
| (1) | HEATING SYSTEM | 60.7% | 14259 | 8659 | 50.4 |
| (2) | WATER HEATER | 82.3% | 3920 | 3227 | 18.8 |
| (3) | REFRIGERATOR | 100.0% | 1320 | 1320 | 7.7 |
| (4) | COOKING STOVE | 99.5% | 1021 | 1016 | 5.9 |
| (5) | FREEZER | 75.7% | 804 | 609 | 3.5 |
| (6) | DISHWASHER | 45.3% | 360 | 163 | 0.9 |
| (7) | CLOTHES WASHER | 83.5% | 90 | 75 | 0.4 |
| (8) | CLOTHES DRYER | 80.9% | 900 | 728 | 4.2 |
| (9) | TELEVISION | 100.0% | 419 | 419 | 2.4 |
| (10) | AIR CONDITIONER | 9.7% | 500 | 48 | 0.3 |
| (11) | LIGHTING | 100.0% | 600 | 600 | 3.5 |
| (12) | MISCELANEOUS | 100.0% | 328 | 328 | 1.9 |
| (13) | TOTAL | | | 17193 | 100.0 |

TABLE B4

END USE ESTIMATES FOR RESIDENTIAL ELECTRICAL USE
FISCAL YEAR 1999/2000

| | ELECTRICAL APPLIANCE OR EQUIPMENT | SATURATION LEVEL | ANNUAL APPLIANCE CONSUMPTION (kWh) | CONTRIBUTION TO AVERAGE HOUSEHOLD CONSUMPTION (kWh) | % OF TOTAL |
|---|---|---|---|---|---|
| (1) | HEATING SYSTEM | 66.3% | 14021 | 9302 | 51.6 |
| (2) | WATER HEATER | 83.8% | 3920 | 3285 | 18.2 |
| (3) | REFRIGERATOR | 100.0% | 1354 | 1354 | 7.5 |
| (4) | COOKING STOVE | 99.8% | 971 | 969 | 5.4 |
| (5) | FREEZER | 79.3% | 784 | 618 | 3.4 |
| (6) | DISHWASHER | 50.6% | 360 | 182 | 1.0 |
| (7) | CLOTHES WASHER | 83.0% | 90 | 75 | 0.4 |
| (8) | CLOTHES DRYER | 82.5% | 900 | 742 | 4.1 |
| (9) | TELEVISION | 100.0% | 441 | 441 | 2.4 |
| (10) | AIR CONDITIONER | 10.6% | 500 | 53 | 0.3 |
| (11) | LIGHTING | 100.0% | 600 | 600 | 3.3 |
| (12) | MISCELANEOUS | 100.0% | 419 | 419 | 2.3 |
| (13) | TOTAL | | | 18040 | 100.0 |

APPENDIX C

## WOOD PROCESSING INDUSTRY

Wood processing related firm industrial transmission sales have grown from 1067 GW.h to some 2658 GW.h between the fiscal years 1971/72 and 1984/85. The 1984/85 sales were some 74% of the firm industrial transmission sales (up from 62% in 1971/72) and 26.5% of the total in-province supply. Most (about 98%) of the industrial transmission electrical sales to the wood processing industry are to the province's eleven pulp and paper mills and the remaining 2% are to lumber, plywood and flakeboard manufacturers. The following discussion focusses on the long term prospects of the pulp and paper industry and its implications for the industrial load forecast.

The five key considerations which are forecast to affect the industry's electrical load requirements are (i) availability of the resource, (ii) demand for the industry's product, (iii) further processing of the final product, (iv) effects of mill modernization and (v) effects of new electro-technology such as high temperature heat pumps.

(i) Resources: Extensive empirical and scientific research related to the availability of wood has been done by the New Brunswick Department of Natural Resources (DNR). Findings of this research indicate that:

> "...no immediate problem with wood supply and, even in the worst situation, no problems closer than 15-20 years".(1)

Wood supply to support the existing industry was therefore not considered to be a constraint in forecasting the load for this

(1) Good Forest Management - A Committment to Action, New Brunswick Department of Natural Resources.

industry. Prudent planning however dictates the need to examine the industry's prospects beyond the fifteen year period. The above mentioned DNR report indicates that under current forest management practices, the province will experience a slight shortage of wood in the period between 30 and 40 years from now. However, there is no imminent depletion of the resource and the industry should therefore continue to be a large consumer of electricity.

The DNR findings also indicate a small excess of hardwood supply, most suitable for fiber based products,(2) which could allow companies using hardwood to increase output. Potential related load addition is estimated at 8 MW.

(ii) Product Demand: Food and Agriculture Organization (FAO) of the United Nations does extensive research on the pulp and paper industry. FAO estimates indicate that the product demand in Canada's main markets, i.e. North America, West Europe and Japan, will increase by an average of little over 3 percent annually(3). This should allow cost competitive New Brunswick producers to maintain the current levels of export and possibly capture some of the growth.

One important development related to potential markets is proposed quota on Canadian newsprint imports by the European Economic Community (EEC). The quota has been set at 600,000 tonnes per year.(4) This compares to some 700,000 tonnes(5)

(2) New Brunswick Forest Industry and Forest Resources; Department of Natural Resources, New Brunswick.
(3) Interim Report of the Forest Industries Advisory Committee to the Honourable Edward C. Lumley, Minister of Industry Trade and Commerce and Regional Economic Expansion.
(4) Pulp and Paper Week, 85-01-07.
(5) Source: Canadian Pulp and Paper Association

shipped by the Canadian producers in 1983, before the quota was established. This load forecast assumes that the proposed quota will not affect markets for N.B. produced newsprint and that if it does the producers will be able to find new markets in the south due to the inflated U.S. dollar.

(iii) Further Product Processing: One example of further processing involves a recent proposal to produce light weight coated paper by integrating the kraft pulp and groundwood pulp from two existing mills.

(iv) Mill Modernization: Modernization at many of New Brunswick mills, as a result of $780 million program[6] started in 1979, has resulted in process change and additional electrical loads. Two key load additions, amounting to some 85 MW, came into effect in 1983. Modernization work is in study stages at two other mills and could lead to further increase of up to 30 MW.

(v) New Technology: Application of electrically driven heat pumps and mechanical vapor recompression equipment to utilize the waste heat in the exhaust steam is supported by recent research.[7] The potential load in newsprint mills through heat pump applications has been estimated at some 20 MW.[8] The potential for heat pumps in the Kraft Mills is the subject of a Canadian Electrical Association research project in progress.

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(6) The Globe and Mail Report on the Forest Industry, July 25, 1983.
(7) Heat Pumping in Industry - A State of the Art Study, C.E.A. Research Report 130 USA.
(8) Potential for Electric Heat Pumps in the Canadian Newsprint Industry, C.E.A. Research Report 124 U 291. The data in this report is under review and revision.

APPENDIX D

## MINING AND SMELTING INDUSTRY

Mining and smelting related firm industrial transmission sales have grown from 356 GW.h to some 626 GW.h between the fiscal years 1971/72 and 1984/85. The 1984/85 mining related sales were some 17.4% of the firm industrial transmission sales and 6.3% of the total in-province supply.

The key considerations which are forecast to affect the industry's electrical load requirements are (i) the potential for new mines, (ii) re-opening of existing mines closed by the decline in the world prices of some minerals and (iii) the potential for further electrification of the mining industry by application of new electro-technologies.

(i) New Mines: Three new potash mines[1] and one tungsten/molybdenum mine have recently started or are expected to start operations within the next five years. One potash mine reached planned production level in 1984 while a second is scheduled to begin operations in the spring of 1985. Work on the third mine is in exploratory stages and potential production is likely to be sometime in the late eighties. A tungsten/molybdenum mine also started production in 1983.

The energy forecast related to the potash mine is based on the 1984 actual performance of the mine in operation. Electrical forecast of the tungsten/melobdenum mine is based on experience so far and changes projected by the Company.

(ii) Re-opening Existing Mines: The recovery in world price of antimony[2] has led to plans for re-opening of a New Brunswick mine which is expected to be in operation by October, 1985. The related load has been included in this forecast.

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(1) For more details on potash development in New Brunswick see Minerals Strategy Update, 1982, Department of Natural Resources.

(iii) Further Electrification: The load at the existing lead smelter may increase if the new technology[3] (developed by the New Brunswick Research and Productivity Council), which is expected to increase metal recovery rate, is adopted over the next few years.

Potential for using electrically operated mining and material handling equipment, use of electricity for underground space heating and the application of heat pumping technology[4] are other areas which would lead to growth in the mining related electrical load. Much of this potential load is not yet quantifiable and has therefore not been included directly in the mining sector's load forecast. For now the provision for such loads is included in the allowance of 5 MW/year for unknown industrial developments.

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(2) The Globe & Mail, July 30, 1984, pp. B5
(3) See the 12th in a series of articles on the mining and smelting industry by A.E. Luetchford, the Daily Gleaner, April 26, 1983.
(4) Canadian Electrical Association has awarded a Research Project to estimate the potential load related to heat pump application in the mining industry.